

POSTOPERATIVE ANALGESIA USING PSOAS SHEATH BLOCK VERSUS THREE-IN-ONE BLOCK IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Captain Cheryl A. Burch

APPROVED:

Eugene Levine, Ph.D., Member Date

Melydia Edge, CRNA, Lt. Col., USAF, NC Date

APPROVED:

F.D. Abdellah, Ed.D., ScD., RN, FAAN Date

Report Documentation Page			Form Approved OMB No. 0704-0188					
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>								
1. REPORT DATE OCT 1999	2. REPORT TYPE N/A	3. DATES COVERED -						
4. TITLE AND SUBTITLE POSTOPERATIVE ANALGESIA USING PSOAS SHEATH BLOCK VS THREE-IN-ONE BLOCK IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION			5a. CONTRACT NUMBER					
			5b. GRANT NUMBER					
			5c. PROGRAM ELEMENT NUMBER					
6. AUTHOR(S) CAPTAIN Cheryl A. Burch, R.N., B.S.N			5d. PROJECT NUMBER					
			5e. TASK NUMBER					
			5f. WORK UNIT NUMBER					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Uniformed Services University of the Health Sciences			8. PERFORMING ORGANIZATION REPORT NUMBER					
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)					
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)					
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited								
13. SUPPLEMENTARY NOTES								
14. ABSTRACT <p>In this study, the effects of two regional anesthetic techniques on postoperative pain of patients undergoing anterior cruciate ligament reconstruction surgery were described. Patients were assigned the morning of surgery to one of two groups. Subjects in Group A received a psoas sheath and sciatic nerve blocks and subjects in Group B received a three-in-one and sciatic nerve block. Additionally, all subjects received either a propofol infusion for sedation or a general inhalational anesthetic. Sixteen subjects were enrolled, 12 in Group A and four in Group B. Mean time from the end of surgery to the patients first request for pain medication was 7.7 hours (SD 1.9) for Group A and 11 hours (SD 1.1) for Group B. Mean time to administer the regional nerve blockade for was 15.3 minutes (SD 7.5; range 7-30) and 23.5 minutes (SD 9.9; range 15-25) for Group A and B respectively. The regional techniques for Group A (n=12, 2=no data) resulted in blockade of all nerves for 8 of the 10 (80%) subjects. The regional techniques for Group B (n=4) yielded two cases which no nerves were blocked and two cases where all nerves were blocked.</p>								
15. SUBJECT TERMS Regional Anesthesia; Lumbar Plexus Block, Postoperative Pain Management; Pre-emptive analgesia								
16. SECURITY CLASSIFICATION OF: <table border="1"> <tr> <td>a. REPORT unclassified</td> <td>b. ABSTRACT unclassified</td> <td>c. THIS PAGE unclassified</td> </tr> </table>			a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 73	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified						

DISCLAIMER STATEMENT

This work was supported by the Uniformed Services University of the Health Sciences Protocol Number T06191. The opinions or assertions contained herein are the private opinions of the author and are not to be construed as official or reflecting the views of the Department of Defense or the Uniformed Services University of the Health Sciences.

COPYRIGHT STATEMENT

The author hereby certifies that the use of any copyrighted material in the thesis entitled:

"POSTOPERATIVE ANALGESIA USING PSOAS SHEATH BLOCK OR THREE IN-ONE BLOCK IN ANTERIOR CRUCIATE LIGAMENT REPAIR SURGERY"

beyond brief excerpts is with the permission of the copyright owner, and will save and hold harmless the Uniformed Services University of the Health Sciences from any damage which may arise from such copyright violations.

ABSTRACT

In this study, the effects of two regional anesthetic techniques on postoperative pain of patients undergoing anterior cruciate ligament reconstruction surgery were described. Patients were assigned the morning of surgery to one of two groups. Subjects in Group A received a psoas sheath and sciatic nerve blocks and subjects in Group B received a three-in-one and sciatic nerve block. Additionally, all subjects received either a propofol infusion for sedation or a general inhalational anesthetic. Sixteen subjects were enrolled, 12 in Group A and four in Group B. Mean time from the end of surgery to the patient's first request for pain medication was 7.7 hours (SD 1.9) for Group A and 11 hours (SD 1.1) for Group B. Mean time to administer the regional nerve blockade for was 15.3 minutes (SD 7.5; range 7-30) and 23.5 minutes (SD 9.9; range 15-25) for Group A and B respectively. The regional techniques for Group A (n=12, 2=no data) resulted in blockade of all nerves for 8 of the 10 (80%) subjects. The regional techniques for Group B (n=4) yielded two cases which no nerves were blocked and two cases where all nerves were blocked.

Key Words: Regional Anesthesia; Lumbar Plexus Block,
Postoperative Pain Management; Pre-emptive analgesia

POSTOPERATIVE ANALGESIA USING PSOAS SHEATH BLOCK VS THREE-IN-ONE BLOCK IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

by

CAPTAIN Cheryl A. Burch, R.N., B.S.N

THESIS

Presented to the Graduate School of Nursing Faculty of
the Uniformed Services University of the Health
Sciences in Partial Fulfillment of the
Requirements for the
Degree of

MASTER OF SCIENCE

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
October 1999

PREFACE

This research was conducted to provide information on two different regional anesthetic techniques and their effect on postoperative pain of patients undergoing anterior cruciate ligament repair surgery.

DEDICATION

To my mother, I dedicate this paper. Thank you for instilling in me the desire for knowledge and for always telling me I could do anything I put my mind to.

TABLE OF CONTENTS

PREFACE	vii
DEDICATION	viii
LIST OF TABLES	xi
CHAPTER I: INTRODUCTION	1
Background	1
Purpose	3
Research Questions	3
Conceptual Framework	4
Neural Circuitry Theory	4
Abdellah's Theory	7
Definitions Conceptual and Operational	11
Measurement	13
Assumptions and Limitations	13
CHAPTER II: REVIEW OF LITERATURE	15
Introduction	15
Clinical Studies	19
Regional Techniques	21
Conclusion	25
Summary	26
CHAPTER III: METHODOLOGY	27
Introduction	27
Design, Sample and Procedures	27

Local Anesthetic.....	29
Sciatic Nerve Blockade.....	29
Three-In-One Nerve Blockade.....	31
Psoas Sheath Nerve Blockade.....	32
Protection of Human Rights.....	34
Data Analysis.....	34
Summary.....	35
CHAPTER IV: ANALYSIS OF DATA.....	36
Introduction.....	36
Sample.....	36
Results.....	37
Summary.....	41
CHAPTER V: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....	43
Introduction.....	43
Discussion.....	43
Conclusions.....	47
Recommendations.....	48
Summary.....	49
REFERENCES.....	50
APPENDICES.....	55
A: Data Collection Tool	
B: Informed Consent	
C: Comments Form	
E: Patient Comments	

LIST OF TABLES

Table 1. Abdellah's Twenty-One Nursing Problems.....	9
Table 2. Demographics of Subjects in Group A (n=12) and Group B (n=4).....	36

CHAPTER I: INTRODUCTION

Introduction

This chapter begins with a discussion of the background of anterior cruciate ligament reconstruction surgery and anesthetic techniques commonly used. This is followed by a statement of the study's purpose, research questions and a discussion of the conceptual framework. The conceptual and operational definitions are presented as well as assumptions and limitations of this study.

Background

Anterior cruciate ligament (ACL) reconstruction surgery is an invasive orthopedic procedure after which patients frequently experience severe postoperative pain (Matheny, Hanks, Rung, Blanda, & Kalenak, 1993). When tissues such as skin and bone are traumatized by surgery, a release of endogenous substances including bradykinin, serotonin and substance P results. Nociceptive stimulation is transmitted to the dorsal root of the spinal cord where a sympathetic reflex is generated. The pain signal is also sent to areas of the brain resulting in pain perception. In addition to causing the perception of discomfort, pain causes alterations in the normal functioning of body systems including respiratory, cardiovascular, gastrointestinal, endocrine, immune and coagulation (Nagelhout & Zagłaniczny, 1997). Uncontrolled pain can also lead to nausea and vomiting which may delay discharge from the hospital.

Postoperative pain is also a common reason for unanticipated hospital admissions.

Poorly managed postoperative pain can lead to undesirable patient outcomes. After ACL reconstruction, pain can inhibit patients' ability to move joints which may then result in adhesions, cartilage resorption and ulceration, capsular and pericapsular contracture and other conditions that can delay or permanently impair the function of the knee. (Brown, Curry, Ruterborries, Avery, & Anson, 1997). In post anesthesia care units, orthopedic patients have the highest incidence of severe pain (16.1%) (Chung, Ritchie, & Su, 1997).

In some hospitals, ACL reconstruction surgeries are performed using peripheral regional anesthesia techniques including intra-articular local anesthetics, combined psoas compartment block and sciatic nerve block, and femoral three-in-one block. These techniques are used not only to block pain and movement during surgery, but also to decrease postoperative pain.

The four major nerves innervate the knee are the lateral femoral cutaneous(Lumbar2-3), femoral(Lumbar2-4), obturator(Lumbar2-4) and sciatic(Lumbar4-Sacral3). A "psoas sheath block" and a "three-in-one block" are two techniques used to block the lumbar plexus from which the first three of these nerves originate (Brown, 1992). Although occasionally the psoas sheath technique can partially block impulse transmission of the sciatic nerve, it usually

requires a separate injection. The three-in-one technique does not block the sciatic nerve transmission (Parkinson, Mueller, Little, & Bailey, 1989). To ensure adequate anesthesia, sciatic nerve impulse transmission must also be blocked with a separate injection.

Various studies have described the utilization of regional anesthesia techniques in anterior cruciate ligament surgery, but few discuss the effectiveness of regional anesthesia in postoperative pain relief. Fewer compare the effectiveness in postoperative pain relief between regional techniques.

Purpose

The purpose of this study was to describe the postoperative pain relief associated with two regional anesthesia techniques administered to patients undergoing anterior cruciate ligament reconstruction surgery.

Variables of interest include:

1. Time from the end of surgery to the patient's first request for pain medicine.
2. Total pain medication required in twenty-four hours.
3. Time required to administer both regional techniques.

Research Questions

1. What are the differences in postoperative pain medication requirements in patients undergoing anterior cruciate ligament reconstruction surgery who have either a psoas sheath block or three-in-one block?
2. Which technique do the patients prefer?
3. Which technique can be performed most expeditiously?

Conceptual Framework

Surgical reconstruction of the anterior cruciate ligament is a painful procedure. Often, patients experience severe postoperative pain (Matheny, et al., 1993).

Two premises guide this study. First, the concept that pain is a neurophysiologic process involving a neural circuit, which transmits the pain signal. Second, pain is a disruption in the continuum of health, a problem that can be identified and solved through a client-centered approach.

Neural Circuitry Theory

Neural circuitry theory proposes that neural impulses travel in a continuous circuit from the brain to the extremities and back to the brain. This theory adheres to concepts developed by Melzack and Wall in the development of the gate-control theory of pain (Kingham, 1994).

There are hypothesized to be five neural circuits that function interrelatedly to lead to a normal baseline sense of the comfortable self, coordinated movement, reflex actions, and the sense of pain. The five circuits are:

1. The neuromatrix to sensory modulator circuit- is the signal from the brain to the peripheral nerve endings.

Kingham discards the concept of nerve endings and defines them as sensory modulators, that is, input to them from the outside environment changes the signal from the brain (Kingham, 1994).

2. The sensory to normal movement circuit-involves the neuromatrix and sensory modulator circuits along with the motoneural circuits. This circuit is involved for example in learning to walk by correctly interpreting the pressure impulse from the ball of the foot as needing to produce a motor response and contract the calf muscle (Kingham, 1994).

3. The pain modulated sensory circuit-is similar to the neuromatrix to sensory modulator circuit. It involves the range of pain sensations as related to the difference in the outgoing (neuromatrix) and incoming (sensory modulator) signals. For example, a pinprick generates less difference in the signal than does a knife slash. The pinprick is perceived as less painful. Each difference in signal generated is compared to the library of signal differences stored in the brain from past experiences and a perception

of pain is generated accordingly (Kingham, 1994).

4. The reflex movement circuit-involves the neuronal short cut at the spinal cord in which a signal from the periphery is transmitted directly to the motoneuronal axon. This protects us from trauma before the brain even perceived what exactly the trauma is (Kingham, 1994).

5. The phantom limb/open circuit-the outgoing signal from the neuromatrix is unopposed because there is no return signal from the periphery, such in the case of an amputated limb. The signal is sent to the brain, which searches for the closest signal match from past experiences and then interprets the signal as burning, itching, etc. This is known as phantom limb pain (Kingham, 1994).

This theory applies to pain caused by surgical manipulation of peripheral tissues. At the extremities, the neural signal is modified by surgical incision. In the spinal cord, the return signal from the extremity, which has now been modified, is compared with the outgoing signal from the brain. If the difference of these two signals is large, a reflex signal is generated from the cord. This signal is then sent to the thalamus and again is compared to the outgoing signal, and the comparison generates a sensory impulse that is sent to the cortex. In the cortex the signal is compared with signals stored from past experience and a perception of the signal is generated.

This theory is significant in managing postoperative pain in knee surgery through the use of regional nerve blockade. Regional nerve blockade is an example of preemptive analgesia. The route of nerve transmission in the neural circuit is blocked before the stimulus (pain) is caused. The pain signal is never transmitted or interpreted. Regional nerve blockade modifies the signal at the periphery so that at the spinal cord, not enough difference is signal in generated between the outgoing and incoming signal to generate a reflex signal to the thalamus. The end result is that pain is not perceived at the cortex (Kingham, 1994).

Abdellah's Theory

Pain from a client-centered approach can be described as a disruption in the patient's state of health. Health can be defined as, "the dynamic pattern of functioning whereby there is a continued interaction with internal and external forces that results in the optimal use of necessary resources that serve to minimize vulnerabilities" (Abdellah & Levine, 1986).

This disruption can be then identified as a nursing problem. In development of her theory, Abdellah (1986) identified twenty-one groups of common nursing problems (see Table 1).

Table 1.Abdellah's Twenty-One Nursing Problems

-
1. To maintain good hygiene and physical comfort.
 2. To promote optimal activity: exercise, rest and sleep.
 3. To promote safety through the prevention of accidents, injury, or other trauma and through the prevention of the spread of infection.
 4. To maintain good body mechanics and prevent and correct deformities.
 5. To facilitate the maintenance of a supply of oxygen to all body cells.
 6. To facilitate the maintenance of nutrition of all body cells.
 7. To facilitate the maintenance of elimination.
 8. To facilitate the maintenance of fluid and electrolyte balance.
 9. To recognize the physiological responses of the body to disease conditions--pathological, physiological, and compensatory.
 10. To facilitate the maintenance of regulatory mechanisms and functions.
 11. To facilitate the maintenance of sensory function.
 12. To identify and accept positive and negative expressions, feelings, and reactions.
 13. To identify and accept the interrelatedness of emotions and organic illness.
 14. To facilitate the maintenance of effective verbal and nonverbal communication.
 15. To promote the development of productive interpersonal relationships
 16. To facilitate progress toward achievement of personal spiritual goals.
 17. To create and/or maintain a therapeutic environment.
 18. To facilitate awareness of self as an individual with varying physical, emotional, and developmental needs.
 19. To accept the optimum possible goals in the light of limitations, physical and emotional.
 20. To use community resources as an aid in resolving problems arising from illness
 21. To understand the role of social problems as influencing factors in the case of illness.

Note. Adapted from Nursing Theorists and Their Work (p.147), by Marriner-Toomey, A., 1994, St. Louis: Mosby.

Abdellah (1986) states that nursing problems are now called patient problems. Once a problem such as pain is identified, it can be grouped into one of these categories. In this study postoperative pain is categorized within Abdellah's problem number one which is, "To maintain good hygiene and physical comfort." Grouping the problem in this manner guides the care delivered or the solution to the problem through implementing the problem-solving approach.

The problem-solving approach proposed by Abdellah (1986) involves the nursing process that includes identifying the problem, selecting pertinent data, formulating a hypothesis, testing the hypothesis through the collection of data, and revising the hypothesis when necessary by incorporating conclusions made from the data collected.

In this study the problem was postoperative pain of patients undergoing anterior cruciate ligament reconstruction. Pertinent data was obtained from two groups. One group was patients who received the three-in-one/sciatic nerve blockade. The second group was patients who received the psoas sheath/sciatic nerve blockade. This study described postoperative pain relief associated with the two techniques.

Definitions-Conceptual and Operational

Pain

Conceptual Definition. "Pain is whatever the experiencing person says it is, existing whenever the experiencing person says it does," (McCaffrey & Beebe, 1989, p. 7). Pain is an interruption in a person's state of health that can be identified and resolved using Abdellah's problem-solving approach. Pain is also defined as a change in neural signal from the periphery and subsequent modification of that signal in the spinal cord. In the cord the modified signal is then compared with the outgoing signal from the brain and then a reflex signal is generated and sent to the thalamus where it is again compared. The thalamus then generates an appropriate signal that is sent to the cortex where it is compared to signals stored from past experiences and the perception of pain is generated.

Operational Definition. Pain will be measured as the time from the end of surgery to the patient's first request for pain medication and by the total pain medication required in the first 24 hours after surgery.

Psoas sheath nerve blockade

Operational definition. A regional anesthetic technique used to block transmission of the nerves of the lumbar plexus including the obturator, femoral, and lateral femoral cutaneous, by injecting 20-25 milliliters of 0.5% ropivacaine

into the psoas sheath via a posterior paraspinal approach to the sheath.

Three-in-one nerve blockade

Operational definition. A regional anesthetic technique used to block transmission of the nerves of the lumbar plexus including the obturator, femoral, and lateral femoral cutaneous, by injecting 20-25 milliliters of 0.5% ropivacaine into the femoral sheath via an anterior paravascular approach.

Sciatic nerve blockade

Operational definition. A regional anesthetic technique used to block transmission of the sciatic nerve by injecting 20-25 milliliters 0.5% ropivacaine around the nerve via a posterior approach to the nerve itself.

Anterior cruciate ligament reconstruction surgery

Operational definition. The anterior cruciate ligament extends posteriorly and laterally from the area anterior to the intercondylar eminence of the tibia to the posterior part of the medial surface of the lateral condyle of the femur. The approach is medial parapatellar with an anterior arthrotomy. Reconstruction is done to this ligament with direct suture, staples or screws. The procedure is often arthroscopically assisted. Following surgery, the knee is immobilized with a long leg splint. The procedure takes approximately two hours.

Measurement

The following variables of interest were measured:

1. Time from end of surgery until the patient's first request for pain medicine. The time of the end of surgery was obtained from the anesthesia record. The time of first pain medicine request was obtained from the patient's medical record.
2. Total amount of pain medication required in 24 hours. Amount and type of pain medication was obtained by patient chart review.
3. Time required for the administration of the three-in-one with sciatic block and the psoas sheath and sciatic block. Time was annotated by the anesthesia provider on the data collection tool.
4. Patient satisfaction with the technique. Patients were asked to comment in writing on their experience and satisfaction with the technique they received on a separate form (Appendix C).

Assumptions and Limitations

Assumptions

1. Pain is an undesirable experience for patients.
analgesia
2. Pre-emptive analgesia can decrease postoperative pain.

Limitation

It is possible that some local anesthetic agents are more or less effective in blocking certain nerves better than others. Patients in this study will receive only ropivacaine. Other types of local anesthetics may provide better outcomes.

Summary

In this chapter the background of anterior cruciate ligament reconstruction surgery and anesthetic techniques commonly used was discussed. A statement of the purpose, research questions and a discussion of the conceptual framework, including Kingham's(1994)and Abdellah's(1986) theories, was covered. Operational and conceptual definitions were presented followed by assumptions and limitations of this study.

CHAPTER II: REVIEW OF LITERATURE

Introduction

In this chapter, historical studies in regional anesthetic techniques are presented, followed by clinical studies related to both pain and regional technique. The chapter ends with a summary of pertinent studies.

Historical Perspective

Until recently, orthopedic surgery patients relied mostly on traditional analgesic methods, such as narcotic administration by injection or by mouth, which requires doses of medication large enough to bring about the possibility of unwanted effects including respiratory depression, sedation and constipation. Neuraxial techniques also have been used to treat postoperative pain in knee surgery. These methods are not always successful and incorporate the risk of central nervous system infection and sympathetic blockade (Bennett, 1994; Ritter, 1995).

Plexus anesthesia, such as the psoas sheath and three-in-one blocks, is used preemptively in lower extremity orthopedic surgery, where satisfactory pain relief is difficult to ensure. Plexus anesthesia is well established and is commonly performed for surgeries of the upper extremity but has not been used as frequently for lower limb procedures (Mansour & Bennetts, 1996). Winnie first described two different approaches to the lumbar plexus

block (Farney, Girard, & Drolet, 1994). Earlier, plexus anesthesia was performed mostly on the upper extremity. Winnie, Ramamurthy, and Durrani, (1973) based the development of the approach to the lumbar plexus on concepts from brachial plexus blocks, first described by Hirschel in 1911. The brachial plexus, enveloped by fascia from the cervical vertebrae to the axilla, has a continuous perineural and perivascular space surrounding the plexus, so that the nerves may be blocked by one injection into the space. Winnie demonstrated use of this concept of blocking the lumbar plexus in an attempt to simplify regional anesthesia of the lower extremity.

The first technique Winnie et al. (1973) described was the three-in-one block also called the inguinal paravascular technique. This involves injection of the lumbar plexus from an anterior approach by inserting a needle just lateral to the femoral artery, eliciting a paresthesia then injecting 20 milliliters of local anesthetic into the femoral sheath. The anesthetic then bathes the femoral, lateral femoral cutaneous and obturator nerves, which were all thought to lie within the sheath.

The second technique used by Winnie et al. (1973) involved injecting posteriorly into the interfascial space between the quadratus lumborum and psoas major muscles. Criticism of the three-in-one technique include

inconsistency in blocking the obturator nerve. The obturator nerve is primarily a motor nerve; however, the anterior branch has sensory distribution to the hip joint, femur and knee joint, and cutaneous innervation to the medial thigh (Ritter, 1995).

Ritter (1995) demonstrated the absence of a femoral nerve sheath capable of conveying either 20 or 40 mililiters of methylene blue dye to the lumbar plexus on six human cadavers. With 40 mililiters of the dye, it was demonstrated that the femoral nerve was always stained, the lateral femoral cutaneous nerve was usually stained, but the obturator nerve was never stained. Parkinson et al.(1989) demonstrated that motor blockade of the obturator nerve was not achieved using the femoral approach with paresthesia on 20 patients. Neither technique described by Winnie produces blockade of the sciatic nerve(lumbosacral plexus)that is also responsible for sensation in the knee. It is also unclear for which type of surgeries Winnie used his technique or the criteria for successful blockade.

Chayen, Nathan and Chayen (1976) described a posterior approach to the lumbar plexus by injection of the psoas compartment at the L-4 level. This approach was developed on the basis that the lumbar plexus nerves and some of the sacral plexus nerves are found in close proximity to each other at this level and lie within the substance of the

psoas muscle. The Chayen et al. technique involved identifying lumbar segment four and inserting the needle three centimeters caudad and five centimeters laterally to the midline until the needle encountered the transverse process of the fifth lumbar vertebrae. The needle was then redirected cephalad until it passed over the top of the transverse process and advanced two centimeters further, which placed the needle in the quadratus lumborum. A loss of resistance technique was then used to advance the needle into the psoas compartment. Chayen et al. suggested that paresthesias may occur, but were not necessary for successful blockade. They also proposed the necessity of a separate blockade of the sciatic nerve to provide analgesia to the entire lower limb. He used this technique successfully (90 of 100 cases) for a variety of lower limb operations including hip nailing, prosthesis and total hip replacements, amputations above and below the knee, femoral and tibial plating and ankle nailing.

Clinical Studies

Pain

Postoperative pain has been shown to have an undesirable effect for patients undergoing anterior cruciate ligament reconstruction. Poorly managed pain inhibits the patient's ability to move the operative joint. Lack of movement may lead to adhesions, muscle atrophy and cartilage

reabsorption, which all may lead to impairment joint function (Brown et al., 1997). Brown et al. evaluated postoperative pain in 100 patients undergoing anterior cruciate ligament reconstruction. Patients were given acetaminophen by mouth four times a day beginning the day prior to surgery. Intraoperatively, Ketorlac was given intravenously and ropivacaine and epinephrine were given intraarticularly. Postoperatively, patients were given fentanyl citrate intravenously for severe pain. All others were given oxycodone by mouth as needed. No regional nerve blocks were used in this study. An association between elevated pain scores on visual analog scale and diminished ability to perform straight leg raises was found. This association suggests that pain may inhibit function and, therefore, early rehabilitation.

Orthopedic surgery in particular is associated with high levels of severe postoperative pain. Chung et al. (1997) prospectively studied 10,008 ambulatory surgical patients, demonstrating that in the post anesthesia care unit orthopedic patients had the highest incidence of severe pain (16.1%) as compared to urologic surgery (13.4%), general surgery (11.5%) and plastic surgery (10%). Ten percent of all unanticipated admissions to the hospital were due to pain. Those with severe pain had a significantly higher incidence of unanticipated admissions (6.4%).

Chung et al. stated that by reducing the incidence of severe pain the duration of stay can be shortened, facilitating early discharge. Methods of analgesia in this study did not include regional techniques. Chung and colleagues also suggested that better methods of postoperative pain relief such as regional techniques were needed. Chung, Un, and Su (1996) also found orthopedic surgery to have one of the highest incidences of postoperative pain, nausea/vomiting, drowsiness and dizziness and suggested that further studies on anesthetic techniques to reduce 24-hour postoperative symptoms were warranted. Again, in this study most (87.9%) received a general anesthetic. Two patient's received spinal anesthesia (0.3%) and none receive regional nerve blockade.

Regional Techniques

Lumbar plexus blocks have been shown to be beneficial to patients postoperatively who have arthrotomy, anterior cruciate ligament reconstruction, synovectomy or cartilage removal from the knee (Bennett, 1994). Bennett compared patients on continuous patient-controlled analgesia(PCA) infusions of morphine for postoperative pain relief with patients who received lumbar plexus blocks, and noted that in the latter group, fewer side effects such as gastrointestinal distress, prutitis and urinary retention were observed. Patients given lumbar plexus blocks also

experienced less change in mentation, had fewer complaints of pain, demonstrated increased cooperation with ambulation and range of motion exercise. Bennett also cited greater patient satisfaction with pain relief from the lumbar plexus block. The incidence of narcotic side effects of nausea, pruritis, sedation and urinary retention were significantly less in the lumbar plexus block group. All patients in this study had general anesthesia but the specific agents used were not mentioned. This confounds the data on postoperative nausea because there is no method to determine whether the general anesthetic agents, the postoperative narcotics or both caused the nausea.

Matheny et al.(1993) retrospectively compared PCA narcotics and continuous lumbar plexus blocks after anterior cruciate ligament reconstruction among 58 patients. They found that the average total dose of narcotic given to patients in the first 24-hours postoperatively was greatly reduced in patient given lumbar plexus block (10.1 mg) than for patient with PCA (91.9 mg). Both sedation ($p=0.0278$) and pruritis ($p=0.0006$) were shown to be significantly less in the lumbar plexus block group. Urinary retention ($p=0.0022$) was considerably less in the lumbar plexus group. Seventeen of 27 patients using the PCA pump required bladder catheterization to relieve urinary retention.

Patel, Flashburg, Paskin & Grossman (1986) compared three-in-one block with general anesthesia in knee arthroscopy. Sixty patients received regional anesthesia. Thirty of these received the three-in-one block and 30 received the three-in-one block with additional injection of the lateral femoral cutaneous nerve. Only two experienced postoperative nausea and vomiting and one experience postoperative pain. This is compared to five of 30 patients receiving general anesthesia with postoperative nausea and vomiting and eight with postoperative pain.

Other studies have compared the effectiveness of different approaches to the lumbar plexus. Parkinson et al. (1989) observed the extent of blockade in four different approaches to the lumbar plexus among 80 patients scheduled for lower extremity surgery. The techniques included: (a) A posterior approach to the psoas sheath at L-3 using nerve stimulation and quadriceps twitch to confirm needle placement; (b) a posterior approach at L4-5, injecting the potential space between the quadratus lumborum and psoas muscles, nerve stimulation and quadriceps muscle twitch was used for confirmation of needle placement; (c) the anterior or femoral sheath approach as described by Winnie et al. (1973) using paresthesia for confirmation of needle placement; and (d) the anterior or femoral sheath approach using nerve stimulation and quadriceps twitch for

confirmation. Twenty patients undergoing lower extremity surgery were assigned to one of the four approaches. The specific type of surgery was not mentioned. The results demonstrated that both posterior approaches were effective in blocking the femoral, lateral femoral cutaneous and obturator nerves but neither technique blocked the sacral plexus (sciatic, tibial, peroneal and posterior femoral cutaneous). Both femoral sheath approaches were effective in blocking the femoral and lateral femoral cutaneous, but routinely spared the obturator nerve. It was suggested then that effective lower extremity blockade can be produced with the addition of a separate sciatic block for all techniques and possibly a separate obturator block when using the anterior approach.

Annapole, Badach, McInerney, Umanoff and Ghobadi (1994) claimed the development of a technique that combined the three-in-one block and sciatic nerve block, using a peripheral nerve stimulator to confirm needle placement for patients undergoing arthroscopic knee surgery. Benefits of this technique in postoperative pain management were obtained by blocking the afferent barrage of the spinal cord during the procedure and discussed. The authors reported a low incidence of nausea/vomiting and no excessive sedation, untoward side effects or complications.

Mansour and Bennett (1996) demonstrated the effectiveness of continuous lumbar plexus block and single-shot sciatic block for postoperative analgesia in anterior cruciate ligament reconstruction and total knee replacement surgery. They suggested that lumbar plexus block alone is inadequate in providing analgesia after major knee surgery because of the innervation to the joint supplied by the sciatic nerve. Their combination technique resulted in good pain relief (score of 1 or 2 on a 1 to 5 scale) in 90-95 percent of patients having cruciate ligament reconstruction and 94-97 percent of patients having total knee replacement.

Others have reported that in addition to knee surgery, the psoas sheath and three-in-one blocks have demonstrated effectiveness in postoperative analgesia after hip surgery (Ben-David, Lee, & Croitoru, 1990; Fournier et al., 1998).

Conclusion

Pain is an undesirable complication of surgery and a high incidence of pain in orthopedic surgery has been established (Brown et al., 1997; Chung et al., 1997). Regional techniques have been shown to be beneficial in postoperative analgesia for knee surgery and have advantages over narcotic administration in that they provide better postoperative pain relief and decrease the untoward side effects of narcotic administration (Bennett, 1994; Matheny et al., 1993).

Studies also have shown effective pain relief and decreased incidence of nausea and vomiting with the three-in-one block versus general anesthesia in knee arthroscopy (Patel et al., 1986). Techniques for blocking the lumbar plexus in lower extremity surgery have been compared for effectiveness in blocking the lumbar plexus (Parkinson et al., 1989).

The necessity of blocking both the lumbar plexus and the sciatic nerve for complete anesthesia of the knee has been established (Annapole et al., 1994; Parkinson et al., 1989). However, studies were not found that describe the effectiveness of the three-in-one block with sciatic block and psoas sheath block with sciatic block with respect to postoperative pain relief. This study will describe the postoperative pain relief associated with these two types of regional blocks in patients undergoing anterior cruciate ligament surgery.

Summary

In this chapter, historical studies in regional anesthetic techniques were presented. Clinical studies in pain and regional technique were discussed and the chapter concludes with a summary of the literature review.

CHAPTER III: METHODOLOGY

Introduction

The design of the study, procedures and sample are described in this chapter. Regional techniques for the three-in-one, psoas sheath and sciatic nerve blockades are described. A description of the local anesthetic ropivacaine is provided. Protection of human rights and confidentiality is also discussed. The chapter concludes with methods for data analysis.

The purpose of this study was to describe postoperative pain medication requirements in patients undergoing anterior cruciate ligament reconstruction surgery who receive either a psoas sheath blockade with sciatic nerve blockade or a three-in-one blockade with sciatic nerve blockade. Both techniques are routinely performed and commonly used for this surgery.

Design, Sample, and Procedures

In this study, patients undergoing anterior cruciate ligament reconstruction surgery were interviewed at the time of their preoperative anesthesia visit; risks and complications of this study were explained by one of the members of the investigative team.

All patients who met the inclusion criteria were invited to participate. Patients considered for inclusion in the study were those that had an ASA classification of I-

III, had no allergies to local anesthetics, were not pregnant, and consented to be in the study. Written informed consent was obtained (Appendix B).

Patients were randomly assigned the morning of surgery to one of two groups. Those in Group A received a psoas sheath and sciatic nerve blockade, while subjects in Group B received a three-in-one and sciatic nerve blockade. A sample of 15 patients per group was determined by power analysis using 80 percent power at .05 level with critical effect size of .70.

During administration of the regional techniques, all patients were monitored by pulse oximeter, non-invasive blood pressure cuff and electrocardiogram as is standard procedure at Malcolm Grow Medical Center. Oxygen was administered at two to three liters per minute by nasal cannula. Emergency airway equipment and advanced cardiac life support medications were available.

Prior to administration of the regional techniques, subjects were premedicated with two to four milligrams of midazolam and up to 100 micrograms of fentanyl at the discretion of the anesthesia provider. After transfer to the operating room, all subjects received either a propofol infusion for sedation or a general inhalational anesthetic.

Postoperative pain medications were ordered by the surgeons using the standard pre-printed postoperative order forms.

Local Anesthetic

Ropivacaine. Ropivacaine HCL is of the amide class of local anesthetics commonly used for nerve infiltration. Local anesthetics reversibly block the generation and conduction of nerve impulses along nerve axons that utilize sodium channels as the primary means of action potential generation. This action is useful clinically to interrupt pain sensation from specific areas of the body. The progression of anesthesia is related to the diameter, myelination and conduction velocity of the nerve fibers. Nerve fibers are blocked in the following order: (a) pain: A-delta and C nerve fibers; (b) temperature: A-delta and C fibers; (c) touch: A-beta nerve fibers; (d) proprioception: A-alpha and A-beta nerve fibers; and (5.) motor: A-alpha (Miller, 1998).

Sciatic Nerve Blockade

Anatomy. The sciatic nerve is formed from the nerve roots from lumbar cord segment four through sacral cord segment three (L-4 to S-3). As the sciatic nerve exits the pelvis, it is anterior to the piriformis muscle. Here, the nerve is joined by the posterior cutaneous nerve of the thigh. At the inferior border of the piriformus, the nerve

is posterior to the obturator internus and quadriceps femoris and anterior to the gluteus maximus. It is also about equal distance from the ischial tuberosity and the greater trochanter of the femur at this point. The sciatic nerve then continues down the extremity where, at the popliteal fossa, it divides into the tibial and common peroneal nerves (Brown, 1992).

Technique. Patients were placed in the lateral position with the operative side upper most. The skin was prepared aseptically with betadine solution. A line was drawn from the posterior superior iliac spine to the middle of the greater trochanter of the femur. A five centimeter line was drawn perpendicular to this line at the midpoint. At the caudal end of the second line, the skin was anesthetized by injecting a small amount of local anesthetic subdermally. A 22-gauge four-inch isoelectric Stimuplex insulated needle was inserted perpendicular to all skin planes, using a current of 1.3 mA, decreasing to 0.4 mA at 1 Hz delivered by a variable output Braun nerve stimulator until dorsiflexion or plantarflexion of the foot was obtained. The needle was then held in place and aspiration attempted. If negative for blood, one milliliter of 0.5% ropivacaine with 1:200,000 epinephrine was injected. If the muscle contraction elicited by the nerve stimulator was stopped, 19-24 milliliters of ropivacaine was injected five milliliters at

a time attempting aspiration after each five milliliters. After 45 minutes, a successful blockade was determined by the patient's response indicating pain to interrogation of the circumference of the knee surface with the nerve stimulator set at 100 hertz. A successful motor blockade was determined by patient's inability to dorsiflex or plantarflex the foot.

Three-In-One Nerve Blockade

Anatomy. The lumbar plexus consists of the first three lumbar nerves and part of the fourth lumbar nerve. The three main nerves of the plexus are the femoral (lumbar 2-4), lateral femoral cutaneous (lumbar 2-3) and the obturator (lumbar 2-4). These nerves exit the pelvis anteriorly. They lie in the fascial plane between the iliacus and the psoas muscle. The concept of the three-in-one block is to inject local anesthetic which should follow the fascial plane to the nerve roots (Brown, 1992).

Technique. Patients were placed in the supine position and the skin over the area to be injected was prepared with betadine solution. A 22-gauge, four-inch Stimuplex insulated needle was inserted using a current of 1.3 mA decreasing to 0.4 mA at 1 Hz delivered by a variable output Braun nerve stimulator caudal to the inguinal ligament and lateral to the femoral artery. The needle was directed cephalad until a contraction of the quadriceps was

visualized. The needle was held in place, aspiration attempted and if negative for blood, one milliliter of 0.5% ropivacaine with 1:200,000 epinephrine was injected. If the contraction of the quadriceps stopped, then 19-24 milliliters, of the anesthetic was injected with aspiration after each five milliliters. Pressure was applied distal to the needle to direct the anesthetic cephalad. The lateral femoral cutaneous nerve innervates the skin of the lateral aspect of the thigh, the obturator nerve, the medial aspect of the thigh and the femoral nerve, the anteromedial aspect of thigh progressing to the medial aspect of the lower leg. After 45 minutes, a successful blockade was determined by sensory response to interrogation of the circumference of the knee surface with the nerve stimulator set at 100 hertz as described in the Sciatic Nerve Blockade section. Successful motor blockade was determined by the patient's inability to extend the leg (femoral nerve) and adduct the leg (obturator nerve).

Psoas Sheath Nerve Blockade

Anatomy. At the level of lumber segments four and five (L4-5), the nerves of the lumbar plexus lie in a fascial sheath between the psoas and the quadratus lumborum muscles. Anesthetic injected into the sheath will bathe the three main nerves and possibly the sciatic nerve (Brown, 1992).

Technique. Patients were placed in the lateral decubitus position with the side to be block uppermost. The skin over the area to be injected was prepared with betadine solution. A line was drawn between the iliac crests. Midline at the fourth lumbar spine was marked. A second line was made five centimeters parasagittally to the midline. This identified the injection site.

A 22-gauge, four-inch insulated Stimuplex needle was inserted using a current of 1.3 mA, decreasing to 0.4mA at 1 Hz using a variable output Braun nerve stimulator. The transverse process of the lumbar five vertebrae was located with the needle. The needle was then slightly withdrawn and redirected cephalad until it slid past the transverse process, and until a quadriceps twitch was visualized. The needle was then held in place and aspiration was attempted. If negative for blood, one milliliter of 0.5% ropivacaine with 1:200,000 epinephrine was injected. If the twitch was eliminated, 19-24 milliliters of ropivacaine was injected with aspiration attempted after each five milliliters. The lateral femoral cutaneous nerve innervates the skin of the lateral aspect of the thigh, the obturator nerve, the medial aspect of the thigh and the femoral nerve, the anteromedial aspect of thigh progressing to the medial aspect of the lower leg. After 45 minutes, a successful sensory blockade was determined by the patients response to interrogation of

the circumference of the knee surface with the nerve stimulator set at 100 hertz as described in the Sciatic Nerve Blockade section. Successful motor blockade was determined by the patient's inability to extend the leg (femoral nerve) and adduct the leg (obturator nerve).

Protection of Human Rights

Risks and complications of the two procedures were explained to the patients during the preoperative anesthesia visit. Written informed consent was obtained (Appendix B). Patients were assured that they could withdraw from the study at any time without jeopardy to themselves. Confidentiality and privacy of all subjects was maintained. Patient names did not appear on any of the data collection tools. Data collection tools were secured in a locked location.

Data Analysis

Descriptive statistics were used for data analysis.

Summary

Design, procedures and sample were discussed in this chapter followed by a description of the regional techniques and anatomy for the three-in-one, psoas sheath and sciatic nerve blockades. A description of the local anesthetic ropivacaine was provided. Protection of human rights and confidentiality is also discussed. The chapter concluded with methods for data analysis.

CHAPTER IV: ANALYSIS OF DATA

Introduction

In this chapter, sample size and demographics are described. A descriptive analysis of the variables is presented and the chapter concludes with a discussion of patient's comments describing their experience.

Sixteen subjects enrolled in the study, 12 received the psoas/sciatic block (Group A) and four received the three-in-one/sciatic block (Group B). This disparity in group size occurred, in part, because the procedure for assigning patients to groups was randomized drawing from a hat. A larger number of patients were in the psoas/sciatic group because five subjects were enrolled in a pilot study prior to randomization of the groups. In these cases, anesthesia providers chose the technique to be performed. All elected to perform the psoas/sciatic technique.

Sample

Subjects were between the ages of 19 and 43, there were 14 males and 2 females. Mean age for Group A was 32 (range 23-43) and for Group B was 30 (range 19-35). Mean weight was 191(SD 34.7) pounds for Group A and 176(SD 35.9) pounds for Group B (see Table 2).

Table 2.Demographics of Subjects in Group A (n=12) and Group B(n=4)

Group	Mean Age/SD(years)	Mean Weight/SD(pounds)	Gender
A	32.7/7.05	191.4/34.7	10-M/2-F
B	30.5/6.7	176.2/35.9	4-M/0-F

Results

The mean time required to administer the regional nerve blockade was 15.3 minutes (SD 7.5; range 7-30 minutes) for patients in Group A, 23.5 minutes (SD 9.9; range 15-25 minutes) for Group B.

Six subjects in Group A had surgery performed under monitored anesthesia care, and six had surgery performed using a general inhalational anesthetic. All patients in Group B received a general inhalational anesthetic. The decision to perform a general anesthetic or monitored anesthesia care was left to the discretion of the anesthesia provider.

Each regional technique was evaluated by testing patient response to electrical nerve stimulation at 100 hertz and by testing the patients ability to move the extremity as explained in Chapter Three. Nerves tested for each procedure were the sciatic nerve (sensory and motor), lateral femoral cutaneous nerve (sensory), obturator nerve

(sensory and motor), and femoral nerve (sensory and motor). The regional technique for Group A (n=12; 2 had no data reported) resulted in blockade of all nerves for 8 of the 10 (80%) patients. In one case, the sciatic nerve was not blocked, and in once case the lateral femoral cutaneous nerve was spared. Assessment of nerve blockade on the two patients in this group was not performed because general anesthesia was induced within fifteen minutes of blockade administration. This duration of time was too short for the local anesthetic to take full effect.

The technique administered for Group B (n=4) yielded two cases in which no nerves were blocked. In the other two cases, blockade of all nerves was achieved.

There were no reported incidents of central nervous system toxicity, neuralgia, or neuropathy in any of the 16 administered regional anesthetics. Two patients had episodes of nausea and/or vomiting in the post-anesthesia care unit. One of these patients received the psoas/sciatic blockade with a general inhalational anesthetic. The other patient received the 3-in-one/sciatic blockade with a general inhalational anesthetic.

The time from the end of surgery, until subjects first request for pain medicine was 7.7 hours mean (SD 1.9) for subjects in Group A (n=12). No data was available for two subjects of this group. Mean time for subjects in Group B

(n=4) was 11.1 hours (SD 1.12). No data was available for two subjects of this group. Results were not statistically significant.

Duration of time from inflation to deflation of the tourniquet for subjects in Group A ranged from 87 to 161 minutes (mean 137 minutes). The time for subjects in Group B total ranged from 104 to 149 minutes (mean 122.6 minutes). No data was available for one subject in this group.

Total pain medication given to patients in the 24-hour post-operative period was not analyzed, because the pain medications given to patients postoperatively varied too much to make comparisons. Combination drugs such as percocet, which consists of oxycodone and tylenol, are difficult to compare pure narcotic or non-steroidal anti-inflammatory (NSAID) drug in their ability to provide pain relief. It is possible to compare a variety of narcotic medications to each other because these drugs have been given a numerical value which may be compared to the standard morphine, which is assigned the value one. This also the case for non-steroidal drugs which can be compared to the standard acetominophen, which is given the value one. The difficulty lies in comparing combination drugs, where there is no standard value given because the medications that make up the drug are of different categories.

Therefore, the total amount of medication given in twenty-four hours was not quantified.

Patients were asked to comment on their experience with the type of regional blockade they received. Specifically, they were asked to comment on whether they were satisfied with the regional technique as well as their experience of pain after surgery.

Eight patients provided written responses, two who received 3-in-one/sciatic blocks and six who received psoas/sciatic blocks. All reported they were satisfied and had received adequate pain relief regardless of the technique they received. One patient wrote, "I had a lumbar block for ACL reconstruction. I thought it was fantastic. I had the same surgery in 1992 with a spinal and there is no comparison". Another wrote, "The type of block I had was the femoral (3-in-one) block. It was very good and it lasted for the whole day." Another patient who received the psoas sheath/sciatic nerve block was happy that "there was no pain after surgery and I was able to eat and drink without difficulty within 20 minutes after getting to my room. It was eight hours before I felt any pain." These comments were typical of all patients (see Appendix D).

Summary

This chapter began with a discussion of the sample size and demographics followed by a descriptive analysis of the variables. The chapter concluded with a discussion of patient's comments.

CHAPTER V: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter begins with a statement of purpose followed by a discussion of the clinically important aspects of this study. The chapter concludes with recommendations for future studies and for clinical practice.

Discussion

The purpose of this study was to describe postoperative pain relief associated with two different regional anesthesia techniques of blocking the nerves of the lumbar plexus in patients undergoing ACL reconstruction surgery. Because of the differences in group size, it was not possible to accurately compare groups. However, in analyzing the data as a whole, there are aspects of this study worth discussing.

The mean duration from the end of surgery to the first request for pain medication was a mean of 7.7 (SD 1.9) hours for subjects in Group A (psoas/sciatic blocks) and 11 hours (SD 1.12) for those in Group B (3-in-one/sciatic). This was not statistically significant. It is known that orthopedic patients have the highest incidence of severe pain postoperatively (Chung et al., 1997). Results from studies have determined that the time from the end of surgery to the need for analgesic intervention is about five hours (+/- 39) minutes from extubation for patients who

receive a 3-in-one block with a general anesthetic in prosthetic hip surgery (Fournier et al., 1998). Patients who have the same surgery with general anesthesia require pain medication in about one hour (+/- 44 minutes).

The concept of pre-emptive analgesia implies that postoperative pain can be reduced if the nerve transmission is blocked prophylactically, before the stimulus is presented (Frandsen, 1997). By using a regional technique, the pain signal is pre-empted in the neural circuit. The signal is never transmitted to the spinal cord and subsequently to the brain. The route of pain transmission and perception is never established. On the contrary, using general anesthesia alone, the pain signal is transmitted, and then must be modified by other means, such as the use of parenteral narcotics.

In this study, 3 of 16 patients (18 percent) in this study required parenteral narcotics in the postoperative period. Of these, one patient received one dose of intravenous morphine (8 mg), one received one dose of intramuscular demerol (75 g) and the third received two doses of intravenous morphine (8 mg total). This low rate of narcotic requirement is consistent with earlier studies comparing patient controlled analgesia and lumbar plexus block for ACL reconstruction. Patient controlled analgesia is a system which the patient is able to deliver their own

parenteral narcotics by activating a machine which delivers medication through their intravenous line. Matheney et al. (1993) demonstrated that the average total dose of narcotic used for patients undergoing ACL reconstruction in the lumbar plexus blockade group was 10.1 mg compared to the 91.9 mg for the PCA group. This is beneficial to the patient as high doses of narcotic are frequently associated with side effects such as nausea, urinary retention, sedation and pruritis, all which may delay discharge. Patel et al. (1986) demonstrated that only one patient in 60 (2 percent) who receive either a 3-in-one block or a 3-in-one plus lateral femoral cutaneous block require analgesics for pain in the postoperative period. In contrast, eight of 30 (26 percent) of patients receiving a general anesthetic for knee surgery required additional pain medicine. In this study, 18 percent (3/16) required parenteral narcotics.

Evaluation of both techniques resulted in all nerves being blocked in 80 percent of subjects in the Group A (8 of 10). In one subject, the sciatic nerve blockade did not work and in the other, the lateral femoral cutaneous nerve was spared. In Group B, however, no nerves were anesthetised in 2 of the four subjects, resulting in a 50% failure rate. This could be attributed to provider technique or possibly to variable human anatomy. Some critics of the 3-in-One technique claim that there is no femoral nerve sheath.

Winnie et al., (1973) hypothesized the existence of a fascial sheath surrounding the femoral nerve. When injected with a volume of local anesthetic, this sheath should carry the medication to the lumbar plexus thereby blocking transmission of the femoral, lateral femoral cutaneous and obturator nerves. The researchers claimed that any volume of 20 cc or greater would be effective. No subsequent studies have reproduced these results (Ritter, 1995).

In Ritter's cadaver study (1995), six fresh adult cadavers were used to evaluate the existence of a femoral nerve sheath. Methylene blue dye in 20 or 40 cc volumes was injected into the femoral nerve. The dye did not reach the lumbar plexus or the obturator nerve in any of the subjects. When 40 cc of dye was injected, it always stained the femoral nerve, usually the lateral femoral cutaneous nerve but never reached the obturator nerve. There was also no gross or microscopic histologic evidence of a femoral nerve sheath.

Regional nerve blockade for knee surgery have been demonstrated to be consistently beneficial in controlling postoperative pain (Fournier et al., 1998). A common misconception that may sometimes dissuade anesthetists from providing these techniques for patients is that they take too long to perform and can delay surgery. Interestingly, the average time to administer both the psoas and sciatic

block was 15.3 minutes (n=12). The 3-in-one/sciatic block averaged 23.5 minutes (n=4). Again it is difficult to compare the two groups because of the difference in group size. The disparity could also be related to provider skill with the technique. For example, in the pilot data for this study, all providers elected to perform the psoas sheath/sciatic technique. At the institution where data was collected for this study, providers perform many psoas/sciatic regional blockade and are very skilled in this technique. Therefore, they might have been able to perform this technique faster than the 3-in-one/sciatic technique.

Another consideration is patient positioning. The 3-in-one/sciatic blockade requires that patients be positioned supine for the 3-in-one, then turned to the lateral position for the sciatic blockade. In contrast, the psoas and sciatic techniques are done without requiring change of position. The average time required for both techniques was just over 19 minutes. If properly planned for, this amount of time should not delay the surgery, especially if the regional techniques are not being given as the sole anesthetic. The nerve blockades should be evaluated before going to the operating room however it is not necessary for the blockade to completely take effect before surgery is begun if the patient is also receiving a general anesthetic. Regional blockade using ropivacaine generally

takes about 30 to 45 minutes. The full sensory blockade in the instance for ACL reconstruction performed under general anesthesia is not required. Complete sensory blockade of the nerves will occur prior to the end of surgery, when it is necessary for control of post-operative pain.

Conclusion

In conclusion, both techniques used in this study provided patients a long duration of postoperative time without requiring pain medication.

In this study there was a low rate of parenteral narcotics used in the postoperative period. The length of time to administer the regional techniques was relatively short in duration, which may encourage some providers to use these procedures for postoperative analgesia. To prevent delay of surgery, patients could arrive 15-20 minutes earlier than normally scheduled in anticipation of block administration. Patients were satisfied with the blocks and the pain relief they received from them.

Recommendations

Recommendations for future studies include:

1. This study should be replicated with:
 - A. A larger number of patients more evenly divided between groups to provide statistical significance to the data obtained
 - B. Addition of a visual analog scale

- C. A qualitative assessment of patient experience by postoperative interview
 - D. Standardation of postoperative medications to be administered to facilitate quantitative comparison.
2. Investigation of other regional techniques such as intra-articular anesthetics and/or narcotics and duration of postoperative pain relief in knee arthroscopy.
- Recommendation for practice: Use of regional blockade of the lumbar plexus and sciatic nerve as a method for providing effective postoperative analgesia for patients undergoing ACL reconstruction.

Summary

This chapter began with a statement of purpose which was followed by a discussion of the clinically important aspects of this study. The chapter concluded with recommendations for future studies and for clinical practice.

REFERENCES

- Abdellah, F.G., & Levine, E. (1986). Better patient care through nursing research. New York: Macmillan.
- Anapolle, D.M., Badach, M., McInerney, V.K., Umanoff, M., & Ghobadi, F. (1994). Knee arthroscopy using regional nerve blockade. Orthopaedic Review, 23, 449-52.
- Ben-David, B., Lee, E., & Croitoru, M. (1990). Psoas block for surgical reconstruction of hip fracture: a case report and description of a catheter technique. Anesthesia and Analgesia, 71, 298-301.
- Bennett, L.P. (1994). Lumbar plexus block for the management of acute pain. Orthopaedic Nursing, 13, 9-14.
- Brown, D.L. (1992). Atlas of regional anesthesia. Philadelphia: W.B. Saunders Company.
- Brown, D.W., Curry, C.M., Ruterborries, L.M., Avery, F.L., & Anson, P.S. (1997). Evaluation of pain after arthroscopically assisted anterior cruciate ligament reconstruction. The American Journal of Sports Medicine, 25, 182-248.
- Chayen, D., Nathan, H., & Chayen, M. (1976). The psoas compartment block. Anesthesiology, 45, 95-99.
- Chung, F., Ritchie, E., & Su, J. (1997). Postoperative pain in ambulatory surgery. Anesthesia and Analgesia, 85, 808-16.

Chung, F., Un, V, & Su, J. (1996). Postoperative symptoms 24 hours after ambulatory anesthesia. Canadian Journal of Anaesthesia, 43, 1121-7.

Farney, J., Girard, M., & Drolet, Pierre (1994). Posterior approach to the lumbar plexus combined with a sciatic nerve block using lidocaine. Canadian Journal of Anaesthesia, 41, 486-91.

Fournier, R., Van Gessel, E., Gaggero, G., Boccovi, S., Forster, A., & Gamulin, Z. (1998). Postoperative analgesia with "3-in-1" femoral nerve block after prosthetic hip surgery. Canadian Journal of Anesthesia, 45, 34-34.

Frandsen, J.L. (1997). Pain management. In J.J. Nagelhout, & K.L. Zaglaniczny, (Eds.), Nurse anesthesia (pp. 1233-46). Philadelphia: W.B. Saunders Company.

Kingham, D.J. (1994). On the general theory of neural circuitry. Medial Hypothesis, 42, 291-98.

Mansour, N.Y., & Bennetts, F.E. (1996). An observational study of combined continuous lumbar plexus and single-shot sciatic nerve blocks for post-knee surgery analgesia. Regional Anesthesia, 21, 287-291.

Matheny, J.M., Hanks, G.A., Rung, G.W., Blanda, J.B., & Kalenak, A. (1993). A comparison of patient-controlled analgesia and continuous lumbar plexus block after anterior cruciate ligament reconstruction. Arthroscopy: The Journal of Arthroscopic and Related Surgery, 9, 87-90.

McCaffery, M., & Beebe, A (1989). Pain: clinical manual for nursing practice. St. Louis: Mosby.

Miller, R.D. (1998). Local Anesthetics. In Katzung, B.G. (Ed.), Basic and Clinical Pharmacology, (7th ed., pp. 425-433). Stamford, Connecticut: Appleton and Lange.

Nagelhout, J.J., & Zaglaniczny, K.L. (1997). Nurse Anesthesia. W.B. Saunders: Philadelphia.

Parkinson, S.K., Mueller, J.B., Little, W.L., & Bailey, S.L. (1989). Extent of blockade with various approaches to the lumbar plexus. Anesthesia and Analgesia, 68, 243-8.

Patel, N.J., Flashburg, M.H., Paskin, S., & Grossman, R. (1986). A regional anesthetic technique compared to general anesthesia for outpatient knee surgery. Anesthesia and Analgesia, 65, 185-7.

Ritter, J.W. (1995). Femoral nerve "sheath" for inguinal paravascular lumbar plexus block is not found in human cadavers. Journal of Clinical Anesthesia, 7, 470-73

Winnie, A.P., Ramamurthy, S., & Durrani, Z. (1973). The inguinal paravascular technic of lumbar plexus anesthesia: the "3-in-1 block". Anesthesia and Analgesia, 52, 989-96.

APPENDICES

Appendix A. Data Collection Tool

Appendix B. Informed Consent

Appendix C. Comments Form

Appendix D. Patient's Comments

APPENDIX A

Data Collection Tool

Data Collection Tool

1. Subject

Identification
number _____
Age _____
Height (inches) _____
Weight(pounds) _____
Gender (circle one) M/F

Surgeon: _____
Anesthesia Provider: _____
Surgery start time: _____
Surgery stop time: _____
Tourniquet time: _____

2. Procedure Time (Block)

Time start: _____
(time marking begins)
Time stop: _____
(last injection complete)

3. Events:

Antiemetics used in PACU(circle one): yes no
CNS toxicity yes no
Neuralgia: yes no
Neuropathy: yes no
Comments:

4. Block (circle one)

1-Psoas/Sciatic

2-Three-in-one/Sciatic

Nerve block obtained after 45 minutes: (circle appropriate answer)

Sciatic: motor: yes no
 sensory: yes no
LFC: yes no
Obturator: sensory: yes no
 motor: yes no
Femoral: sensory: yes no
 motor: yes no

5. Medications

Total volume of ropivacaine used _____

Premedications: _____

Intraoperative: _____

Total amount _____
narcotic given _____
during surgery: _____

Time/Date of subject's first request for pain medicine_____

Total amount/name pain medicine require 24-hours post-op_____

6. Anesthesia

(circle one)

MAC(Medications)_____

General(Medications)_____

Other_____

7. Other Operative Procedures

Please list procedures performed in addition to the ACL

reconstruction_____

APPENDIX B

Informed Consent

Informed Consent Form
Research Study

POSTOPERATIVE ANALGESIA USING PSOAS SHEATH BLOCK OR THREE-IN-ONE BLOCK IN ANTERIOR CRUCIATE LIGAMENT REPAIR SURGERY

My name is Capt. Cheryl A. Burch. I am a Nurse Anesthesia graduate student conducting research for my masters thesis. You are being asked to take part in a research study. Before you decide to be a part of this research study, you need to understand the risks and benefits so that you can make an informed decision. This is known as informed consent. This consent form provides information about the research study which has been explained to you. Once you understand the study and the tests it requires, you will be asked to sign this form if you desire to participate in the study. Your decision to participate is voluntary. This means that you are free to choose if you will take part in the study.

Purpose and Procedures

The Department of Nursing Anesthesia of the Uniformed Services University of the Health Sciences is carrying out this research study to find out which of two types of commonly performed regional nerve blocks results in better pain relief after anterior cruciate ligament repair surgery. Twenty volunteers will be asked to participate in this research study.

The two types of blocks used are the psoas sheath block with sciatic block and the three-in-one block with sciatic block. Both of these nerve blocks anesthetize or block the nerves which provide sensation to the knee joint. These blocks will be administered in addition to the general anesthesia you will receive. Both blocks consist of two injections

given after numbing the skin. The injections for the psoas sheath block is into the area of the psoas muscle which is in your lower back. The sciatic nerve is block by injection into the buttocks. The three-in-one block is done by injection into the groin.

After your surgery is done and you are recovering, you will be asked to rate the level of pain you are experiencing on a visual analog scale. You will be given medication to relieve any discomfort if you need them. You will also be asked to comment in writing on a form provided regarding your experience with the type of block you receive.

Benefits

The benefits of this study are that you may be more comfortable after surgery and require less pain medication than if the surgery were performed without regional blocks.

Time Commitment

There is no additional time commitment or increase in the length of your hospital stay.

Risks, Inconveniences, Discomforts

The potential risks of this study may include: bleeding, discomfort, or infection at the injection sites; failure of the blocks to provide pain relief; potential allergic reaction to the local anesthetic used. You may also experience anxiety related to the procedure.

Cost of Participation

None to you.

Pregnancy and Allergies

No pregnant women will be considered for this study or any subject who is allergic to local anesthetics.

Research Related Injury

This study should not entail any physical or mental risk beyond those described above. We do not expect complications to occur, but if, for any reason, you feel that continuing this study would constitute a hardship for you, we will end your participation in the study.

DoD will provide medical care at government facilities for any DoD eligible for injury or illness resulting from participation in this research. Such care may not be available to other research participants. Compensation may be available through judicial avenues to non-active duty research participants if they are injured through the negligence (fault) of the Government.

If at any time you believe you have suffered an injury or illness as a result of participating in this research project you should contact the Office of Research Administration at the Uniformed Services University of the Health Sciences, Bethesda, MD 20814 at (301) 295-3303. This office can review the matter with you, can provide you information about your rights as a subject, and may be able to identify resources available to you. Information about judicial avenues of compensation is available from the University's General Counsel (301) 295-3028.

Confidentiality of Records

All information that you provide as a part of this study will be confidential and will be protected to the fullest extent of the law. Information that you provide and other records related to this study will be kept private, accessible only to those persons directly involved in conducting this study and members of the Uniformed Services University of the Health Sciences' Institutional Review Board, who provide oversight for human use

protection. All questionnaires and forms will be kept in a restricted access, locked cabinet while not in use. However, please be advised that under UCMJ, a military member's confidentiality cannot be strictly guaranteed. To enhance the privacy of your responses you will not be identified on any of the data collection tools utilized. Any reports generated from this study will not divulge your name or identity.

Withdrawal

I understand that I may at any time during the course of this research study revoke my consent, and withdraw from the study without prejudice. I have been given an opportunity to ask questions concerning this research study, and any such questions have been answered to my complete satisfaction. Call Capt Cheryl Burch at (301) 869-3183, if you have any concerns, questions, or Maura S. McAuliffe Ph.D., CRNA at 301-295-6565, chair of my thesis committee. If you have any questions about your rights as a research subject, you should call the Director of Research Programs in the Office of Research at the Uniformed Services University of the Health Sciences at (301) 295-3303. This person is your representative and has no connection to the researchers conducting this study.

I do hereby volunteer to participate in a research study entitled:
POSTOPERATIVE ANALGESIA USING PSOAS SHEATH BLOCK OR THREE-IN-ONE BLOCK IN ANTERIOR CRUCIATE LIGAMENT SURGERY. The implications of my voluntary participation: the nature, duration and purpose; the methods and means by which it is to be conducted; and the inconveniences and hazards to be expected have been thoroughly explained to me by _____.

By signing this consent form you are agreeing that the study has been explained to you and that you understand this study. You are signing that you agree to take part in this study. You will be given a copy of this consent form.

I have been given the opportunity to ask questions concerning this study, and any such questions have been answered to my full and complete satisfaction.

Signature

Date

Signature (witness)

Date

I Certify that the research study has been explained to the above individual, by me, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered.

Investigator

Date

APPENDIX C

Comments Form

PATIENT'S COMMENTS

Please use this form to write down any comments that you can provide us about the type of block you received for your knee surgery. Specifically comment on whether or not you were satisfied with the block and why. Also, comment on your experience of pain after your surgery.

(you may continue on back)

APPENDIX D

Patient's Comments

Patient Comments

Group A (Psoas/Sciatic)

1. Yes, I was satisfied with the block. The numbness gave me the chance to get comfortable before the pain set in. Also, the pain set in slowly as the block wore off. Instead of waking up with extreme pain, this gave me a chance to control the pain before it became bad.

2. I had a psoas/sciatic block for ACL reconstruction. I thought it was fantastic. I had the same surgery in 1992 with a spinal. There is no comparison. The lumbar block lasted over 12 hours and I felt no pain during that time. I was able to tolerate medications as the block wore off. Even the next day, I only needed minimum medications. I would definitely recommend this type of block and would have it done again.

3. I received the psoas/sciatic block for ACL reconstruction. I was very satisfied with the block as it seemed to reduce the lengths of severe pain. The pain did not even surface until about 12 hours after surgery. I felt very comfortable in the days following surgery and after 5 days had almost no pain. I only took one percocet during the first three days after surgery. I thought the block was very helpful and would recommend it to anyone having surgery of this type.

4. The psoas/sciatic nerve block that was administered before my surgery was an excellent choice. The provider explained the procedure and I felt comfortable with the decision to proceed with the block. The worse part of the whole surgery was getting the IV started. I do not remember anything about the procedure, but afterwards, I did not have any feeling in my leg until 9:30 p.m. (about 8 1/2 hours). The pain I had after that was just a dull ache. I was totally satisfied.

5. I had no pain after surgery and I was able to eat and drink without difficulty within 20 minutes of returning to my room. It was eight hours before I felt any pain and twelve hours before I had any movement in my toes.

6. I received the psoas/sciatic nerve block. It provided good pain support during the night. I still had residual numbness in my toes the next morning.

Group B (3-in-one/sciatic)

1. The 3-in-one block worked well. I didn't have any pain until about 10:00 at night (about 12 hours after surgery ended). I was very satisfied with how well the block worked.

2. I had the 3-in-one block. It was very good and lasted the entire day. The only pain I had was under my leg near my hamstring muscle. That was it.